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of Some Measures of Financial Risk

Inga S. Baird
D. Sudharshan

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Inga S. Baird, Graduate Student
Department of Business Administration

D. Sudharshan, Assistant Professor
Department of Business Administration

Summary:

Increasing attention is being paid to the concept of strategic groups in the field of strategic management. Extant studies have attempted to identify and describe strategic groups in different industries by using production or marketing variables or measures of investor behavior. In this study, accounting measures of financial strategies were used as a proxy for strategic behavior in examining group composition in the office equipment/electronic computing industry. These measures were analyzed using the technique of Three Mode Factor Analysis. Results obtained significantly expand current understanding of strategic group membership.

Strategic Groups: A Three Mode Factor Analysis of Some Measures of Financial Risk

Increasing attention is being paid to the concept of strategic groups in the field of strategic management. Extant studies have attempted to identify and describe strategic groups in different industries by using production or marketing variables or measures of investor behavior. In this study, accounting measures of the riskiness of financial strategies were used as a proxy for strategic behavior as a basis for examining group composition in the office equipment/ electronic computing industry. These measures were used in conjunction with the analytic tool of Three-Mode-Factor Analysis to develop an understanding of strategic groups in the computing industry.

The idea of strategic groups was initially proposed by Hunt (1972) to explain the existence of four different, distinctive, successful strategies followed by members of the home appliance industry. Since then, this concept of strategic groups has served industrial economists as a convenient intervening construct between the firm and the industry which can help explain the structure-conduct-performance linkage (McGee, 1982). The initial conceptualization of strategic groups by Hunt focused on particular product-market segments and similarity of competitor behavior in regards to their strategic actions. However, further researchers in the area have used somewhat different definitions of strategic groups. Newman (1975) identified them by the relationship between the companies' actions in a particular industry and participation in other industries, resulting in forming groups based primarily on vertical integration criteria. Porter's (1979) operational definition of strategic groups

involved measures of market share as a basis for grouping companies into "leader" and "follower" classes. His research focused on primarily production and marketing measures to test differences in behavior between these two groups in several consumer goods industries. However, all of these studies have concentrated primarily on two functional areas—production and marketing—to study the conduct of strategic group members.

Several researchers (Hatten, Schendel and Cooper, 1978; Primeaux, 1982; Ryans and Wittink, 1982) have been interested in the importance of financial strategy to group formation and performance. While studying the brewing industry, Hatten, Schendel and Cooper (1978) included two financial variables in addition to their manufacturing and marketing variables. They used the Total Debt/Invested Capital ratio as a measure of leverage and a dummy variable indicating the presence or absence of merger and acquisition behavior in their regression equation models to test for differences between three groups identified from a previous intensive industry analysis. They found that regional and semiregional brewers benefited from the increased use of leverage, but adequate conclusions could not be drawn about the national or small regional brewers. The merger and acquisition variable was significant for the industry equation but not for any of the group equations. They suggest that the lack of significant relationships between merger and performance in any groups may have been due to the failure to study a lagged effect of this variable.

Primeaux (1982) is also studying a financial variable which might be used in forming strategic groups. He hypothesized that investment behavior as measured by net capital expenditures may be an important

variable which can be used to identify the industry life cycle stage a company is in. Strategic groups can then be characterized by their life cycle stage. Primeaux is pursuing a study of how possible groups may vary on these measures.

Ryans and Wittink (1982), using a security market measure of risk taking, namely residuals of a market model of security returns, were able to form strategic groups in the airline industry, during the period deregulation of that industry went into effect. Their work suggests that the risk involved in financial strategies might be an important variable on which strategic groups would vary, but their measure of risk is a market determined, investor oriented one, rather than one which more closely mirrors managerial behavior. Therefore, it was decided to use accounting measures of risk, which have been shown by Beaver, Kettler and Scholes (1970) and Bildersee (1975) to be associated with market models of risk, in this study. These accounting measures of risk may be used by investors in making stock purchase decisions, but perhaps represent managerial decision more closely because one intervening construct in the chain has been removed. Figure 1 provides a simple conceptualization of the link of the two types of measures of financial risk, accounting measures and market measures, and management and investor strategies. The accounting measures are seen to more closely reflect managerial strategies involving such decisions as dividend policy, the amount of debt a company can or should bear, etc. Therefore, the strategic groups formed will be based more on management behavior than investor behavior.

Insert Figure 1 About Here

It was necessary, in order to study the grouping of companies on financial risk variables, to find an industry with particular characteristics. First, the industry should be subject to at least a moderate amount of environmental complexity and dynamism. This would enable an examination of an interesting problem, where the respective managements would have to formulate and implement strategies to compete in a common environment. However, the environment would pose uncertainties for managers which would test their willingness and ability to manage financial risk in strategy formulation. The second criterion involved finding an industry wherein the majority of the firms were not widely diversified. This was a practical requirement in that widely diversified firms with several SBU's/divisions in various industries could not demonstrate differences in within-industry financial strategy particularly since financial measures of individual division performance were not easily obtainable.

The office equipment/electronic computing industry met these requirements and was chosen. A five year time period, 1977-1981, was also selected. This period was characterized by technological, competitive and economic dynamism as well as the inclusion of some new competitors for whom financial data was available for five but not ten years.

Between 1977-81 the industry had faced three major trends or changes. First, the rise in the importance of mini and micro processors due to developments in chip technology had changed the complexion of business data processing and opened up the field of personal computing, encouraging new entrants into the industry. Second, the way had been paved by Amdahl for the development of plug compatible equipment. Manufacturers

were able to produce components which could be used in conjunction with a mainframe computer of any make (usually IBM). This allowed these companies to forge ahead in limited areas of technology without being concerned with problems of designing and making central processing units and again encouraged many firms to enter the industry. A third trend in the industry dealt with the increasing sophistication and availability of software. While the equipment portion of the industry became increasingly standardized and mature particularly in the mainframe segment, software development continued to increase in importance and breadth of application on a wide variety of equipment types.

These industry characteristics suggested the possibility that within the office equipment/electronic computing industry, a variety of strategies characterized by different risk levels could be identified. Therefore, an attempt was made to classify industry firms into strategic groups based on measures of financial risk taking.

Methodology

The sample consisted of all firms in the office equipment/electronic computing industry (SIC 357x) for whom financial data were available on Compustat tapes. Of the 55 companies (Table 1) who were listed as in

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Insert Table 1 About Here
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the industry, data were available for the five year period, 1977-1981, on 46 companies. Therefore, analysis proceeded on this sample. The nine companies which were deleted typically were new entrants for whom information covering the entire time period was not available.

Therefore, if the sample is biased, it is toward the older and probably somewhat more risk averse firms. However, 13 of the 46 companies used were 10 years older or less, so new firms composed about one-third of the sample.

The accounting risk measures selected for use were: current ratio, debt to equity ratio, return on assets, dividend payout ratio, times interest earned and size. The current ratio (CR) is a measure of a company's ability to cover its short term liabilities through use of its current assets. A 1:1 current ratio or less is seen as rather risky, because the firm is not generating enough cash to cover its current obligations, however, too high a CR may indicate poor cash management. Debt to equity ratio (D/E) was chosen as a leverage measure. In times of high interest rates, a high D/E ratio may indicate excessive use of debt financing which may impose heavy interest charges on the firm. It may reduce profits which will be a risky course of action in the stockholders' and managers' eyes and cause high debt charges, a risky action in debt holders' view. Return on assets (ROA) was chosen as a profitability measure simply based on the idea that a profitable firm is seen as having more flexibility to pursue any course of action since it has the funds to finance the innovation and a cushion of investor confidence which can be relied on if more funds are needed. Dividend payout (DP) was included as a common measure of financial risk, involving the percentage of earnings paid out in dividends. A high DP ratio may indicate the company is not retaining enough earnings to finance its growth or is perhaps continuing a fixed level dividend regardless of earnings, both risky courses of action. However, it may

also be associated with reluctance to use debt financing and the costs
of relying on equity capital. The fifth ratio calculated was times
interest earned (TIE). Poor interest coverage would indicate a risk
taking firm. A size measure, logarithm of total assets, was also
included based on the idea that larger companies are often older and
less prone to take risks.

The financial ratios chosen were calculated using the X-Ratio sub-
file associated with the Compustat system. Documentation of ratio
calculation formulas used by the program is available from the authors.

Since it was felt that strategic groups would exhibit moderate sta-
bility over time, it was necessary to select an analytic technique which
would allow simultaneous study of companies, financial variables and
time. Therefore, Three-Mode Factor Analysis (Tucker, 1966) was used to
give a picture of strategic groups consisting of firms which exhibit
similar financial behavior in the relevant time period.

The data were standardized and the analysis performed using the
VII.TM1 program available on SOUPAC at the University of Illinois,
Urbana-Champaign. This program yields a factor analytic solution to a
three dimensional i by j by k data matrix. In this analysis, i repre-
sents companies, j represents the risk variables and k represents the
five years. The input data matrix consisted of standardized scores in
the two dimensional form $_iK_{jk}$ where row entries, i, represent company
data and column entries represent combinations of modes j and k with
the time mode, k, nested within the ratio mode, j. Through factoring,
it is possible to reduce the observational modes (i, j, k) to a set of

derivational modes (m, p, q). The fundamental three-mode factor analysis model can be stated by the equation:

$$\tilde{x}_{ijk} = \Sigma\ \Sigma\ \Sigma\ a_{im}b_{jp}c_{kq}g_{mpq}$$

where:

$\tilde{x}_{ijk}$ = an approximation of the observed score x_{ijk}

a_{im}, b_{jp}, c_{kq} = entries in the two mode matrices, $_iA_m$, $_jB_p$, and $_kC_q$ which describe elements in the observational mode in terms of elements in the derivational mode.

g_{mpq} = entries in the three dimensional core matrix G.

In matrix form the model would be stated:

$$X_{ijk} = {}_iA_m G_{(pq)}\left({}_pB_j X_q C_k\right)$$

where:

X = Kronecker product.

$_iA_m, _pB_j, _qC_k$ = factor solutions for modes i, j, and k.

G = core matrix of the derivational modes.

X = matrix representing the observational modes.

Output of Part one of the analysis yields the cross products matrices, eigenvalues and eigenvectors of each mode, as well as the core matrix of the unrotated factor solution. The number of components retained for each mode in the final solution were determined using scree tests, as suggested by Tucker (1966). Such tests (Figures 2a, 2b, and 2c) show that six factors need to be retained in the i mode, and three

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Insert Figure 2 About Here
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in each of the other modes. These factors were rotated using a Varimax rotation and then submitted to Part two of the program. Input to Part

two consists of the unrotated core matrix from Part one and the trans-
formation matrices from the modes which were rotated. Output from Part
two is the transformed core matrix, which indicates the simultaneous
relationships among the three modes.

<div align="center">Results</div>

Risk Variables

Loadings after Varimax rotation indicated close to simple structure
had been achieved for this mode. Loadings on the respective factors
are shown in Table 2. Although labeling is tenuous, illustrative

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Insert Table 2 About Here

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factor names were applied to provide greater interpretability in the
core matrix and better suggest applicability of three-mode analysis.
The first variables factor is comprised of just the dividend payout
variable which may be summarized as an investor/market directed factor.
The second factor, on the other hand, seems to represent variables which
suggest sophistication of liquidity management. Sophistication in cash
management, as seen by loadings on this factor, seem to be directly
related to size. It appears that larger firms had better cash manage-
ment techniques which allowed them to keep their current ratios low.
Smaller firms with rapid growth, sudden inflows of cash, and perhaps
some difficulty getting short term financing had higher current ratios.
Thus, this factor may be more a measure of management sophistication
and size than risk taking.

The three variables showing up on Factor 3 represent a company's
ability to generate earnings to cover its debt payments. Although many

of the older companies had probably found long term debt a rather cheap
form of capital in earlier periods, with rising interest rates, new
companies as well as older companies desirous of going to the debt
markets found this an expensive source of funds. Those firms which had
to rely on new debt financing probably suffered a decline in ROA due to
high interest charges and a subsequent decline in the times interest
earned figure. Thus, this factor provides a set of variables which may
clearly distinguish between strategic groups in regards to their source
of financing and its effects on returns. Alternatively, it may distin-
guish firms willing to sacrifice current ROA in hopes of growth generated
through debt financing which may improve long run ROA prospects.

Time Mode

In the time mode, again simple structure was achieved. 1977 and
1978 loaded separately on two factors. However, 1979-1981 loaded on a
third factor. (See Table 2). During 1977 and 1978 the move toward
mini and micro computers and plug compatible equipment was gaining
momentum, while economic problems in the form of high interest rates
were characteristic of the 1979-81 period.

Company Mode

The six factors retained in the company mode accounted for 82.5% of
the variance, but six companies did not load heavily on any one factor.
Companies which loaded similarly on a particular factor are considered
a strategic group, in keeping with Tucker (1966) who suggests that the
factors which emerge from the subject or company (i) mode may be inter-
preted as representing an ideal type for objects which load heavily on

that factor. Factors 1, 2, and 3 had only one company load on them
(see Table 3), indicating these companies pursued somewhat unique

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Insert Table 3 About Here
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financial strategies. Applied Devices (Group 1) was characterized by
an initial position in 1977 of high current ratio and low size, with an
average dividend payout ratio and average debt/equity and return. In
1978, its debt/equity rose sharply while ROA declined as did the current
ratio, with DP remaining stable. During 1979-81, its DP declined to a
relatively low position while D/E remained very high, ROA was depressed
and CR was about average. Applied Devices' financial structure became
much riskier over the five year period studied. This pattern is derived
from examination of the rotated core matrix, which is found in Table 4.

Insert Table 4 About Here

Pioneer Texas was the only company to enter Group 2, but its pattern
is somewhat similar to Applied Devices'. In 1977 their positions were
roughly equivalent. However, in 1978, Pioneer's debt/equity ratio rose
to an extremely high level while ROA declined to negative levels. DP
was cut sharply. In the next three years, Pioneer managed to reduce D/E
significantly while increasing ROA slightly and resuming an average level
of dividend payout.

Electronic Associates (Group 3) showed a huge dividend payout during
1977 with a miniscule ROA (.0007). ROA increased somewhat over the next
four years and the dividend payout percentage was reduced accordingly.

During the whole period, Electronic Associates' current ratio was maintained at high levels, while D/E was about average. Electronic Associates evidently adopted the rather risky position of maintaining an even dividend payout regardless of the level of earnings.

In contrast to the rather unique, risky; financial strategies followed by the previous three firms, the companies which load heavily on Factor 4 are much more conservative. During 1977 and 1978 they maintained a low DP policy, and evidenced steady growth in asset size, probably financed from internally generated or equity funding as their D/E position remained very low and ROA very high. However, during 1979-81, their ROA declined somewhat and D/E increased, although they remained close to industry averages. Members of this group pursued a very risk-averse course of financial strategy which appeared to be quite successful.

On Factor 5, there were two groups of companies which loaded heavily--some positively and some negatively. The firms in the positive loading group (Group 5+) were generally small companies with high current ratios and average DP over the five year period. However, while their D/E was initially high and ROA low, they steadily improved their D/E position until it was better than the industry average, while ROA increased similarly. It may be suggested that these companies used debt financing to get started--perhaps a necessary risk to finance future growth--and were able to adopt a less risky course of action as their earnings allowed.

The group of firms which loaded negatively on Factor 5 (Group 5-) were in a strategically interesting but perhaps less favorable position.

Many of the old giants of the various industry segments are found in this group, as indicated by their low CR/high size position over the five year period. Their dividend payout remained fairly constant while their debt/equity ratio increased steadily. ROA and times interest earned declined. Due to lack of technological innovation, perhaps, and the inability or lack of desire to retain funds to try to attain break-throughs in technology, these companies relied more heavily on expensive debt during the 1979-81 period, which further depressed ROA and ability to maintain production, R & D, and marketing leadership in their fields. They might be characterized as companies forced into risky financial strategies because of their unwillingness to take R & D risks.

For Factor 6, again two groups were identified. Those companies which loaded positively on Factor 6 (Group 6+) were characterized by average to low dividend payout and very low debt/equity ratios over the complete five year period. However, during this period, their size increased steadily while CR fell. This might be described as the conservative growth group. They were able to use equity and retained earnings to generate excellent returns and significant growth.

The companies which loaded negatively on Factor 6 (Group 6-) showed a great deal of movement in their financial ratios. For many of the companies the movement was in the wrong direction. Beginning in 1977, the firms had very high D/E ratios with low ROA which was maintained through 1981. However, throughout the period, they also maintained a relatively high dividend payout. Interestingly, their current ratio rose steadily while size decreased relative to other firms, indicating perhaps that these firms grew more slowly than their competitors, due in part to the financial strategies followed.

Discussion

This study has demonstrated that it is possible to identify several rather stable groups in the office equipment/electronic computing industry which differ in terms of their financial policies. In the past, Caves and Porter (1977) have been most concerned with the ability of strategic groups to formulate a common strategy which can be defended against imitators by the erection of mobility barriers. However, if companies are grouped based on the riskiness of their financial policies, mobility barriers will be of less concern and effectiveness a more important concern. It is not too difficult to vote a large dividend or to borrow money. What is of interest is the return earned by companies which pursue the various strategies. In this industry, the highest returns were earned by those companies pursuing the most conservative financial policies.

Although the direction of causality in this conservative-return relationship has not been tested in this study, it may be possible to see whether mobility barriers do exist which allow firms in conservative groups to maintain their high profit levels. The older, larger, more conservative firms associated with Group 4 have been able to generate the funds necessary for technological risk taking by earning high returns on early innovations and retaining these funds to finance further growth without having to rely heavily on debt financing. Thus, their early product market success coupled with financial conservatism has placed them in positions which cannot be easily imitated by competitors. Their past strategies have also currently placed them in a position where they can continue to be financially conservative.

The companies which were in Group 6+ are also quite conservative, but smaller firms. It may be that they are in the earlier stages of successful imitation of the Group 4 strategy. If they have the products and desire necessary for continued growth, they may be able perhaps to enter Group 4. In fact, on cluster analysis, most of the new entrants to Group 4 in 1980 came from the 1977 grouping of smaller, successful, financially risk-averse firms.

The dilemma of the companies in Group 5- is clear. These are the large, old firms in their segment of the industry. However, it may be appropriate to suggest that they have limited their chances of mobility into other higher return groups by their finanicial policies. By maintaining relatively high dividend payouts, they may have failed to retain the funds necessary to generate innovation or to move by acquisition into more rapidly growing industry segments. Their heavier reliance on debt financing during the period of the study, also attenuated their ability to generate growth funds that enable higher ROA in the long run. Thus, their past financial policies may have constrained their ability to make significant strategic change at this point even if they immediately try to adopt a different financial course of action.

The companies which fall into other strategic groups are fairly small and are perhaps still more concerned with developing a distinctive product, and surviving to be concerned with financial policy. However, results of this paper may indicate for them a good course to pursue, once survival is assured. The dichotomous nature of this industry, where financial conservatism is needed in conjunction with technological risk taking is fascinating. However, it is probable that

in some industries, financial risk taking is critical for success.
Thus, it is necessary to extend this analysis to other industries to
determine if similar strategic groups can be identified in different
contexts. It may also be beneficial to apply this type of analysis to
firms of different ages in different industries to assess the importance
of industry-life cycle interactions. However, for the field of strate-
gic management, it may be important to expand the concept of strategic
groups to include financial and risk taking characteristics of the groups.

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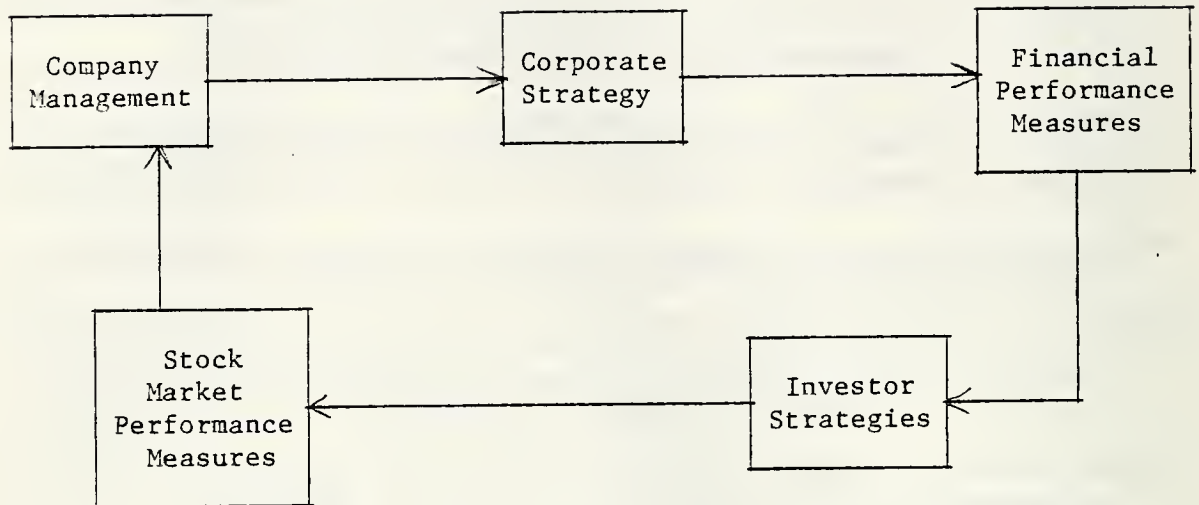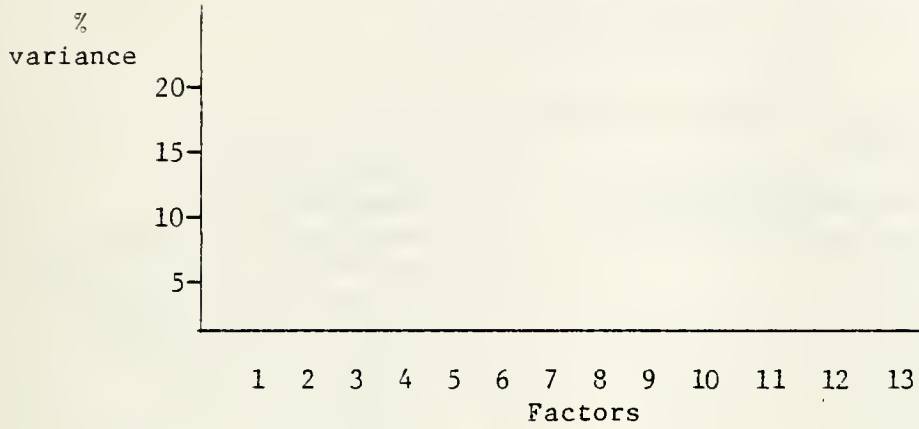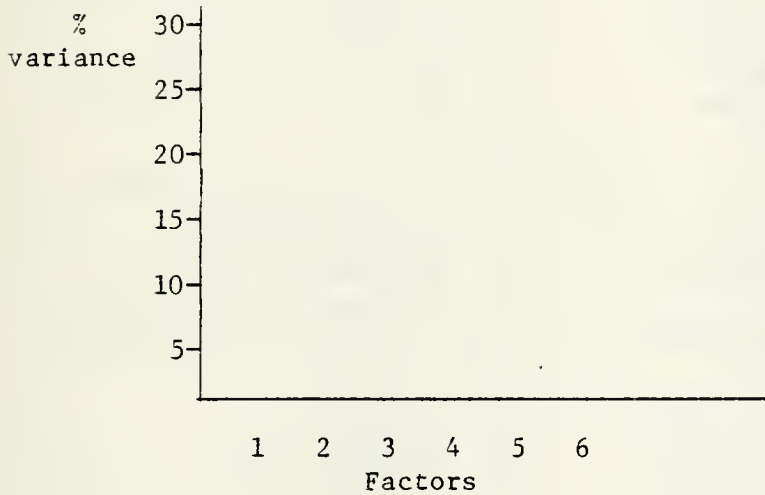
Figure 1

Figure 2

Scree Tests for Each of Three Modes
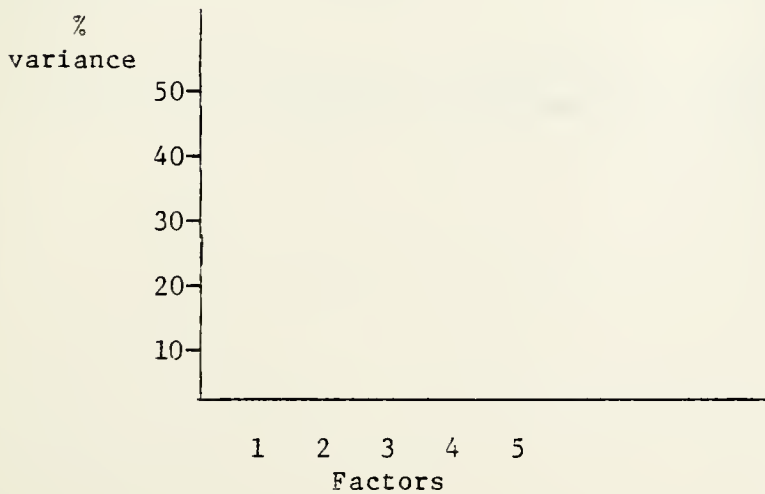
a) i Mode

b) j Mode

c) k Mode

Table 1

Companies in the Office Equipment/Electronic Computing Industry
Listed on Compustat

1	Burroughs Corp.	29	Hazettine Corp.
2	Hunt Mfg.	30	Hewlett-Packard Co.
3	Intl Business Machines Corp.	31	Honeywell Inc.
4	Litton Industries Inc.	32	Lanier Business Products Inc.
5	MSI Data Corp.	33	Lundy Electronics & Systems
6	Mangood Corp.	34	Management Assistance
7	NCR Corp.	35	Modular Computer Systems
8	Pitney-Bowes Inc.	36	Mohawk Data Sciences
9	Rockaway Corp.	37	Pioneer Texas Corp.
10	Amdahl Corp.	38	Prime Computer
11	Applied Devices	39	Recognition Equipment Inc.
12	Applied Magnetics Corp.	40	Reynolds & Reynolds
13	Barry Wright Corp.	41	Sperry Corp.
14	Beehive International	42	Storage Technology Corp.
15	Centronics Data Computer	43	TEC Inc.
16	Commodore Intl Ltd.	44	Telex
17	Computer Consoles	45	Vermont Research Inc.
18	Control Data Corp.	46	Wang Laboratories
19	Cray Research	47	Anderson Jacobson, Inc.
20	Data Access Systems, Inc.	48	Computervision Corp.
21	Data General Corp.	49	Floating Point Systems Inc.
22	Data Terminal Systems Inc.	50	Intertec Data Systems Corp.
23	Datapoint Corp.	51	NBI Inc.
24	Dataproducts Corp.	52	Rolm Corp.
25	Digital Equipment	53	Ultimate Corp.
26	Electronic Associates Inc.	54	Verbatim Corp.
27	Electronic Memories & Magnet	55	Wesper Corp.
28	Genisco Technology		

Companies with missing values excluded from the sample.

Table 2

Matrices for the Variable and Time Modes

Financial Strategy Variables

	Investor treatment orientation	Liquidity management sophistication	Debt aversion
	Factor 1	Factor 2	Factor 3
CR	-.083	.618*	.231
ROA	-.036	.028	.640
D/E	-.234	.112	-.576*
DP	.935*	.041	.021
TIE	-.230	.138	.406*
Size	-.094	-.764*	.200

Time Mode

	Economic downturn	Microprocessor/ PCM entry	Microprocessor/ PCM growth
	Factor 1	Factor 2	Factor 3
1977	.008	.999*	-.000
1978	.018	-.000	.986*
1979	.418*	.026	.088
1980	.694*	-.031	.037
1981	.586*	.004	-.137

*Variables included on that factor.

Table 3

Strategic Groups in the Office Equipment/Electronic Computing Industry
1977-1981

Group 1	Group 2	Group 3	Group 4
Applied Devices	Pioneer Texas	Electronic Associates	IBM
			MSI
			Amdahl
			Barry Wright
			Centronics
			Data General
			Data Terminals
			Hewlett-Packard

Group 5+	Group 5-	Group 6+	Group 6-
Hunt Mfg.	Burroughs	Cray Research	Mangood
Mangood	Litton	Digital Equipment Corporation	Genisco
Rockaway	NCR		Applied Magnetics
Computer Consoles	Pitney Bowes	Dataproducts	Beehive
Data Access	Control Data	Electronic Memories	Commodore Int'l.
Modular Computer Systems	Honeywell	Prime Computer	Lundy Electronics and Systems
TEC Inc.	Sperry Corp.	Reynolds & Reynolds	
Vermont Research	Storage Technology	Wang Laboratories	

Table 4

Transformed Core Matrix

Core Matrix for Company Mode, Factor 1

	1977	1978	1979
DP	.603	.216	-1.187
CR/Size	1.823	.182	.521
D/E, ROA, TIE	-10.292	-.133	-1.931

Core Matrix for Company Mode, Factor 2

	1977	1978	1979
DP	-.191	-1.725	.608
CR/Size	1.090	.697	.104
D/E, ROA, TIE	.014	-10.824	-.301

Core Matrix for Company Mode, Factor 3

	1977	1978	1979
DP	14.253	.150	.521
CR/Size	1.283	.647	1.174
D/E, ROA, TIE	-.646	-.111	.066

Core Matrix for Company Mode, Factor 4

	1977	1978	1979
DP	-2.444	-1.500	-1.04
CR/Size	.168	.958	-1.975
D/E, ROA, TIE	6.935	5.388	-.406

Core Matrix for Company Mode, Factor 5

	1977	1978	1979
DP	-.027	.523	.039
CR/Size	7.685	5.298	10.037
D/E, ROA, TIE	-.203	.193	1.346

Core Matrix for Company Mode, Factor 6

	1977	1978	1979
DP	-1.205	-.542	-.521
DR/Size	4.477	-.453	-2.286
D/E, ROA, TIE	5.411	3.657	5.065